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M E M O R A N D U M

DATE: March 25, 2011

TO: Alderman Marcia T. Johnson, Chairman, and
Members of the Zoning and Planning Committee

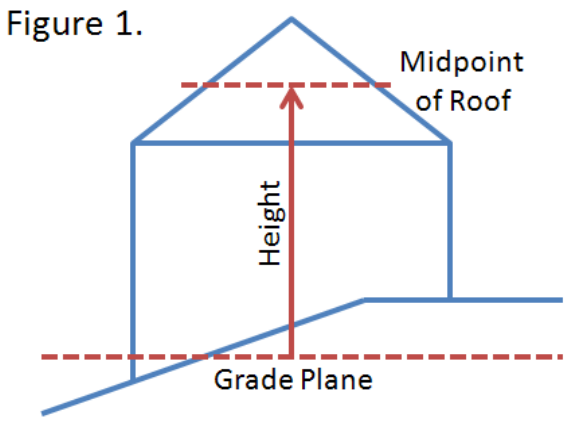
FROM: Candace Havens, Director of Planning and Development
Jennifer Molinsky, Interim Chief Planner for Long-Range Planning
Seth Zeren, Chief Zoning Code Official

RE: **Working Session**
Petition #17-11. Terrence P. Morris, Joseph Porter, Bruce Bradford, George Collins, Verne T. Porter, Jr., and Michael Peirce, proposing an amendment to the zoning ordinance for the purpose of changing the definition of "Grade Plane" and adding a new definition of "Average Grade."

On February 28, 2011, the petitioners presented a proposal, which relates to the definition and measurement of "grade plane." This memo presents the Planning Department's analysis of the proposal. The Department agrees that the current definition of grade plane can be improved with the changes proposed in petition #17-11, though we have recommendations about the specific language discussed in this memo. We further recommend that this petition be heard together with petition #65-11, proposing a change to the Zoning Ordinance's definition of "height," as the two items are closely related.

I. Current Grade Plane Definition

In the Zoning Ordinance, "grade plane" represents the average grade of a structure at ground level. It is a single number that is calculated from points surrounding a structure. It is important because the grade plane is the level from which maximum allowed height is measured. On a sloping lot, someone seeking to maximize height would want as high an average grade plane as possible from which to measure maximum allowable height (see Figures 1 and 2 below).



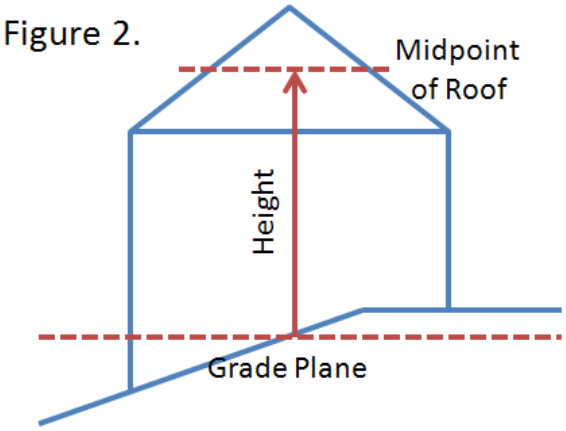


Figure 1 and Figure 2 show the effect of different Grade Plane calculations on the overall height of a building. Maximum allowed height is measured from the grade plane. A higher grade plane calculation leads to a taller building if built to allowable height.

Grade plane is also used in determining whether a story counts as a basement or a first story, of particular importance on sloping lots where large portions of basement walls may be above grade (such as walk-out basements). Whether or not a story counts as a basement is meaningful for FAR calculations (both under the current FAR system and the system coming into effect on October 15, 2011) and because the Zoning Ordinance excludes basements from the maximum allowed number of stories.

The current definition of grade plane in the Zoning Ordinance is as follows (with interpretation of this language in parentheses in bold):

> *"Grade Plane*: A reference plane for a building or structure as a whole **(that is, a plane that encircles the building or structure)** representing the average of finished ground level adjoining the building or structure at all exterior walls **(at least one measurement must be taken at each exterior wall)**. In calculating said reference plane, the elevation of each point used to calculate said average shall be determined by using the lowest elevation of finished ground level with in the area **(wall)** immediately adjoining the building or structure **(flush against the wall)** and either the lot line or a point six (6) feet **(perpendicular)** from the building or structure, whichever is closer to the building or structure, as illustrated in the diagrams below."

As a result, a measurement of a rectangular building with four exterior walls requires at least eight measurements: one flush against each wall at the lowest point (four total) and one six feet out from those four spots (for a total of eight) (see Figure 3 below).

Figure 3.

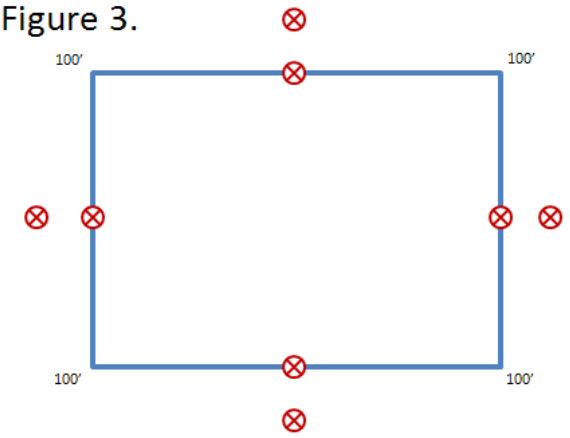
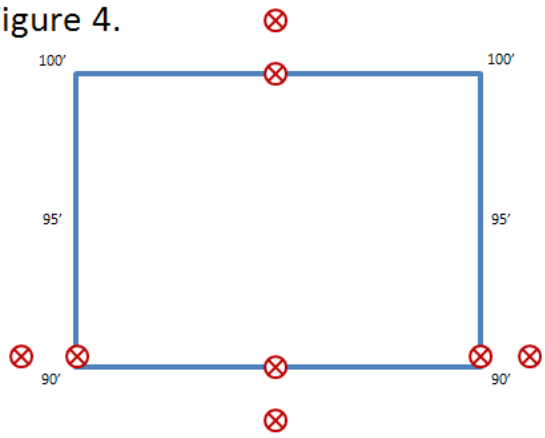


Figure 4.



According to the Inspectional Services Department (ISD), there are two related problems with the current definition of "grade plane" in the Zoning Ordinance:

1. **The calculation of grade plane, as defined in the current Zoning Ordinance, has been manipulated by those measuring it to produce a more desirable base from which to measure height.** Over the years, ISD has regularly received plans from engineers who have used a variety of interpretations of the Zoning Ordinance's definition of grade plane in their calculations. The measurements have been inconsistent and difficult to verify. To remedy this problem, ISD issued detailed guidance in December 2010, based on a close reading by ISD and the Law Department of the existing definition of "grade plane" to ensure a more standardized application of the grade plane definition.

2. **When the definition of grade plane is applied as directed by the existing definition, it may not produce an *average* grade**. Instead, it can produce a grade plane that is actually *lower* than the average grade around a property. Under the current definition, the grade plane calculation may not result in a true average grade on a sloping lot, because the measurements must be taken at the *lowest* elevation on a given side. A simplified example (see Figure 4 above) assumes that the property slopes evenly from 100' in the rear to 90' in the front. Under the current grade plane definition, the measurements would be taken at the lowest point of each wall (both against the wall and six feet out). Averaging these eight points produces a lower grade plane (92.5 feet) than the actual average (95 feet) of all the elevations.

II. Proposal

In order to improve the calculation of grade plane and ensure that it produces a true average, Petition #17-11 proposes replacing the current definition with a length-weighted average method similar to that used by the Town of Weston. The length-weighted mean approach first calculates the average grade for each wall segment (by averaging the two ends) and then weights each segment grade by the length of the segment (thus a wall that is 40 feet long would "count" four times as much as another wall that is only 10 feet long). All of these segment grades are then averaged together to produce the final average grade plane.

The petition proposes deleting the current definition of grade plane (shown above) and replacing it with the following:

"Grade Plane: A horizontal reference plane for a building as a whole, passing through the elevation of the finished Average Grade around the perimeter of a building, from which building height is determined."

"Average Grade: The average of the grade elevations around the perimeter of a building, as determined by the following length-weighted mean formula: the sum of [(e1+e2)/2 x L]/P, where S is a segment of the building perimeter with a consistent grade or slope; e1 and e2 are the grades at the respective ends of the segment; L is the corresponding length of the segment; and P is the length of the total building perimeter. In calculating said average, the elevation of each point used to define each segment shall be determined by using the lowest elevation of finished ground level with in the area immediately adjoining the building and either the lot line or a distance six (6) feet from the building, whichever is closer to the building, as illustrated in the diagrams below."

III. Analysis

The Planning Department's analysis involved the following:

- Examining the general merits and the specific language of the proposed method for calculating grade plane
- Researching how other communities calculate grade plane, including how the length-weighted mean approach has worked for those communities that use the method
- Considering the impact the change in method might have on building outcomes in Newton
- Examining the Zoning Ordinance as a whole to identify any potential unintended consequences

The Inspectional Services and Law Departments worked closely with the Planning Department in its analysis.

Proposed Method for Calculating Grade Plane

The proposed length-weighted mean method of calculating grade plane achieves a fairer and more representative average grade plane than the current method. By using wall segments in the calculation rather than requiring a single point on each side, it is possible to accurately calculate grade plane along walls with varying grades (as in the case of homes with basement garages or sloping lots).

Comparisons with other communities

The applicants stated in the presentation to the Committee on February 28th that they were drawing upon a practice used by Sudbury and Weston, MA. The Planning Department conducted phone interviews with the inspectors/zoning enforcement officers from both towns to better understand how the length-weighted mean approach has worked in their communities. Staff from both communities reported that the method works well; staff from Weston reported that the method is clear and consistent and reduces "gaming" of the system.

The Planning Department also studied the zoning ordinances of neighboring communities. Some municipalities (Needham and Wellesley) do not define a specific calculation for grade plane other than to indicate that it is the grade adjoining the building. Brookline, Watertown, and Waltham do define a calculation. Brookline's approach varies depending on the status of adjoining lots and the relative relationship to the street grade. Watertown requires that the grade be averaged from measurements along each wall (30 foot increments) and at each corner. Waltham requires measurements every 20 feet around the perimeter and limits "berming" near structures.

Impact of Proposed Method of Calculating Grade Plane

The Planning Department performed sample calculations using both the existing definition and the proposed approach on three hypothetical representative houses: a house on a flat lot, a house on a lot with a sloping grade from front to rear exposing a walk-out basement, and a house with a basement garage in the front on a largely flat lot.

The analysis found that, on a flat lot, the current and proposed calculations produced the same grade plane calculation. In both the sloping grade and the basement garage examples, the proposed calculation gave grade plane values one to two feet higher than the City's current calculation (see Attachment A). However, it should be noted that until December 2010, when ISD issued guidance on interpreting the current grade plane definition, grade plane calculations were often manipulated to produce higher grade planes from which to measure height. Therefore there may be little actual change in building height if the new proposal is adopted. (See Attachment A for an example of how the new grade plane would be calculated.)

ISD and the Planning Department concur that the general method of taking a weighted average of grades surrounding a property is better than the current method laid out in the Zoning Ordinance. It is less easily manipulated and more likely to produce a true average grade. In general the new method may allow for higher grade planes for buildings on sloping lots than the current definition, but as the resulting grade plane is actually an average grade plane, the Planning Department does not see this as a problem.

As noted earlier, grade plane also matters in calculating whether or not a story is considered a basement under the Zoning Ordinance. For one- and two-family residences, a story is a basement if one-half or more of the distance between the floor and ceiling of the floor above lies below the average grade plane; for all other buildings, the story must be two-thirds below the average grade to count as a basement. One possible result of changing the grade plane definition is that, for structures on sloping lots, it could be slightly easier for a story to count as a basement rather than a first story, because the average grade plane would likely be slightly higher than it would be if calculated under the current definition.

Suggested Changes to Proposed Method of Calculating Grade Plane

The Planning Department recommends some revisions to clarify the proposed language, as set out below:

> *Grade Plane:* A horizontal reference plane for a building as a whole, passing through the elevation of the finished Average Grade around the perimeter of a building, from which building height is determined."
>
> *Grade, Average:* The average of the grade elevations around the perimeter of a building, as determined by the length-weighted mean formula below. All walls of length greater than six feet shall be included in segments of consistent grade or slope.
>
> $$\frac{\Sigma[(e1 + e2)/2 \times L]}{P}$$
>
> Where:
> - Σ sums all segments
> - e1 and e2 are the elevations of the finished ground level at the respective ends of each segment, determined as the lowest point at each end of the segment within six feet of the foundation or the lot line, whichever is closer
> - L is the corresponding horizontal length of the segment
> - P is the total horizontal length of all segments

This revised language builds off of the language of the petition (which itself is derived from the Weston, MA zoning by-law) and adapts it for Newton. In particular, Newton's existing approach of measuring, either at the wall or the lowest point within six feet of the wall, is preserved as a tool to prevent "creative" berming around houses being used to inflate the grade plane and, thus, allowed height. The title of the definition has been adjusted so that it will be located next to the other grade-related definitions in the Ordinance. ISD suggests that several diagrams, similar to the ones already present in the ordinance, would be included with the definition in the Zoning Ordinance to make clear how the definition should be applied.

Conformity with the Ordinance

As indicated above, the proposed definition change significantly connects to definition of "height" and "basement." The Planning Department examined the ordinance for other potential consequences from the proposed change and found none.

IV. Recommendations

The Planning and Inspectional Services Departments recommend the adoption of the definition as revised in this memorandum. This new length-weighted mean approach has been proven to be effective in other cities and towns. The new approach makes calculations of grade plane more certain, more fair, and less prone to "gaming." Planning and ISD also encourage the Committee to consider petition #65-11 concerning revision of the "height" definition alongside petition #17-11 as both would work together to significantly affect the measurement and regulation of building height in Newton.